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WHC-IP-0716

Corrosion in Waste Drums from the 183-H Solar Evaporation Basin Cleanout Project

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Corrosion in Waste Drums from the 183-H Solar Evaporation Basin Cleanout Project	WHC-IP-0716	0	2 of 48
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Abstract

9413137.2049

EXECUTIVE SUMMARY

Drums of waste from the cleanout of the 183-H solar evaporation basins have been stored on the Mixed Waste Storage Pad in the Hanford Central Waste Complex in the 200 West Area. In July 1990, during an operation to highlight fading drum labels, it was noted that several 183-H basin waste drums were leaking.

This report describes ultrasonic inspection results from efforts to characterize drum degradation and analyzes the causes of the degradation.

Pitting corrosion is identified as the cause of the drum failures. Necessary factors in the corrosion were failure of plastic liners inside the drums, allowing corroding species from the waste to contact the drum internal surfaces, and the high volume of free liquids in the waste. A significant accelerating factor was the high ambient temperature and direct sun exposure of the failed drums. The specific corrodant was probably sodium nitrate, although other chemicals present in the waste could have contributed to corrosion.

More reliable means of waste storage are necessary. This includes elimination of free liquids, a reliable barrier between the waste and the drum interior wall, and minimization of exposure to atmospheric extremes of temperature.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

This letter report is intended to document, from a corrosion standpoint, the causes of the leakage discovered in 55-gal drums on the mixed waste storage pad in the Hanford Central Waste Complex (HCWC) during July 1990.

The report is intended as a follow-up to action item 8.12 of a Critique Report (Maier 1990) describing leakage from 183-H Basin waste drums stored in the HCWC. That action item called for nondestructive inspection of leaking and nonleaking drums to determine effectiveness of such inspection techniques in finding and characterizing corrosion damage.

2.0 BACKGROUND AND EVENT DESCRIPTION

Four of 16 flocculation and sedimentation basins in the 100-H Area were used for solar evaporation of the liquid chemical wastes resulting from N-Reactor fuel fabrication. These basins last received waste in November 1985. In 1985 cleanout of the basins was initiated and shipment of 183-H waste in 55-gal drums to storage areas in the 200 West Area began. These actions were performed in compliance with decontamination and decommissioning activities at the Hanford Site and the 183-H Solar Evaporation Basins Closure/Post-closure Plan (DOE-RL 1990).

At the end of FY 1990 approximately 11,000 55-gal drums of 183-H Basin waste had been shipped to the 200 West Area. Less than 2,000 drum equivalents of waste remain in one of the basins (Basin #2). The drums were shipped to various locations in the 200 West Area, as shown in Table 1. This table does not reflect the most recent movement of approximately 70 corroded drums back to the 183-H basins for repackaging.

The bulk of the wastes discharged into the basins consisted of spent acid etch solutions (primarily nitric, sulfuric, hydrofluoric, and chromic acids). These solutions were neutralized with excess sodium hydroxide before being transported to the basins. Other wastes discharged to the basins included unused chemicals, used battery acids, plating solutions, and other wastes. The basin wastes have been designated as low-level mixed wastes.

Extensive sampling of the basin wastes have been performed. The wastes were determined to consist of three phases in general: liquids, wet sludge, and a relatively dry phase. Analyses of the basin wastes are given in DOE-RL (1990).

The events surrounding the discovery of the corroded drums are summarized in Maier (1990). On July 11, 1990, 20 drums at the HCWC were identified as leaking. In addition, approximately 20 other drums were identified as potential failures. The potential failures were so designated from blisters on the drum exteriors which had no visible leakage or holes. All of the drums contained sludge and sandblast grit and were stored on an outside storage pad at the HCWC. The drums were packaged with two 10-mil polyethylene liners inside U.S. Department of Transportation (DOT) 17H 55-gal drums.

Table 1. Waste Drum Storage Locations - 183-H Basin.

Facility	Drum Quantity
HCWC Mixed Waste Storage Pad	2,377
Burial Ground 218-W-04C, Trench 24	3,230
HCWC Mixed Waste Storage Bldg 2402B	1
HCWC Mixed Waste Storage Bldg 2402C	24
HCWC Mixed Waste Storage Bldg 2402D	978
HCWC Mixed Waste Storage Bldg 2402F	1,056
HCWC Mixed Waste Storage Bldg 2402H	596
HCWC Mixed Waste Storage Bldg 2402I	598
HCWC Mixed Waste Storage Bldg 2402J	540
HCWC Mixed Waste Storage Bldg 2401L	56
HCWC Mixed Waste Storage Bldg 2402W	36
Burial Ground 218-W-3AE, Trench 05	1,990
TOTAL	11,482

3.0 DRUM EXAMINATIONS

The identification numbers of the drums positively identified as having leaks are given in Table 2, along with the date that they were received at the HCWC. A total of 42 failed drums had been identified at the time of this report. The date the drums were filled with waste is not available, but the drums are required to be shipped within 90 d of filling. The time period between filling (assumed to be an average of 45 d prior to shipping, in the absence of any definite information) and leakage discovery was used to determine the corrosion rate, along with a nominal 43 mils wall thickness. This wall thickness was taken from an average of ultrasonic readings of the drum walls. The DOT specifications for wall thickness of sheet metal for production of DOT 17H drums state a nominal .0478 in. thickness with a minimum of .0428 in. The maximum possible time taken for penetration of the drum walls ranged from approximately 1 to 2 yr. This resulted in a minimum or lower bound corrosion rate ranging from 22 to 45 mils/yr.

The results from visual examination of the drums during efforts to repackage into sound drums are given in Appendix A. Packing inspection sheets from the re-packaging task are given for four leaking and four nonleaking drums in the appendix. The nonleaking drums were included as controls and to see if incipient leaks could be found prior to through-wall penetration. As part of the inspection, samples of liquid from inside the drums and samples of material which had been forced out of the corroded areas onto the drum exterior were taken. Readings of the pH of liquid in four of the drums were also taken, with observations from pH 10-11. Results of analyses of material from drum exterior surfaces are given in Appendix B. The principal constituent in all four cases was sodium nitrate. Sodium fluoride sulfate (Na_3FSO_4) was present in two of the samples in the 10-20 atomic % range and oxonium iron sulfate hydroxide $H_3OFe_3(SO_4)_2(OH)_6$ was present at less than 5% in one sample.

Photographs taken during the re-packaging operation are shown in Figures 1 and 2. Note the granular absorbent material and liquid being removed from the drum in Figure 1, and the sampling operation in Figure 2.

All drums that failed had black painted surfaces. Other drums with similar waste which have not failed had yellow or galvanized steel surfaces. The failures occurred during a period of hot weather in which the ambient temperature exceeded 100 °F. No temperature readings within the drum interiors were taken, but a mercury thermometer was attached to the exterior so that the bulb was touching the black painted side. The thermometer reached a maximum of 131 °F. The temperatures inside the black drums have been estimated at well over 200 °F. This is supported by calculations performed for temperatures in the interior of galvanized drums, which were determined to be 183 °F for a drum in full sun with 110 °F air temperature (Campbell 1980). A black drum surface would absorb more heat than the reflective galvanized surface.

Table 2. Leaking Drum Identification. (2 pages)

Drum ID	Receipt Date	Assumed Date of Filling	Time to Leakage (days)	Minimum Corrosion Rate (mils/yr)
88-D-28	8-26-88	7-12-88	729	~22
88-D-343	9-02-88	7-19-88	722	~22
88-D-438	9-07-88	7-24-88	717	~22
88-D-446	9-07-88	7-24-88	717	~22
88-D-448	9-07-88	7-24-88	717	~22
88-D-471	9-07-88	7-24-88	717	~22
88-D-594	9-09-88	7-26-88	715	~22
88-D-837	9-13-88	7-30-88	711	~22
88-D-1204	9-23-88	8-09-88	701	~22
88-D-1390	9-30-88	8-16-88	694	~23
88-D-1375	9-30-88	8-16-88	694	~23
88-D-1407	11-04-88	9-20-88	659	~24
183-H4-31	8-26-88	7-12-88	729	~22
183-H4-79	8-29-88	7-15-88	726	~22
183-H4-299	8-31-88	7-17-88	724	~22
183-H4-308	9-02-88	7-19-88	722	~22
183-H4-320	9-02-88	7-19-88	722	~22
183-H4-340	9-02-88	7-19-88	722	~22
183-H4-357	9-02-88	7-19-88	722	~22
183-H4-605	9-09-88	7-26-88	715	~22
183-H4-703	9-12-88	7-29-88	712	~22
183-H4-828	9-13-88	7-30-88	711	~22
183-H4-1163	9-22-88	8-08-88	702	~22

Table 2. Leaking Drum Identification. (2 pages)

Drum ID	Receipt Date	Assumed Date of Filling	Time to Leakage (days)	Minimum Corrosion Rate (mils/yr)
183-H4-1201	9-23-88	8-09-88	701	~22
183-H4-1203	9-23-88	8-09-88	701	~22
183-H4-1282	9-27-88	8-13-88	696	~23
183-H4-1286	9-27-88	8-13-88	696	~23
183-H4-1288	9-27-88	8-13-88	696	~23
183-H4-1291	9-27-88	8-13-88	696	~23
183-H4-1296	9-27-88	8-13-88	696	~23
183-H4-1408	11-04-88	9-20-88	659	~24
89-DD-0013	9-05-89	7-22-89	354	~44
89-DD-0036	9-05-89	7-22-89	354	~44
89-DD-0038	9-05-89	7-22-89	354	~44
89-DD-0039	9-05-89	7-22-89	354	~44
89-DD-0050	9-05-89	7-22-89	354	~44
89-DD-0062	9-12-89	7-29-89	347	~45
89-DD-0063	9-12-89	7-29-89	347	~45
89-DD-0064	9-12-89	7-29-89	347	~45
89-DD-0076	9-12-89	7-29-89	347	~45
89-DD-0107	9-12-89	7-29-89	347	~45
89-DD-0108	9-12-89	7-29-89	347	~45

Figure 1. Drum Opening During Re-packaging Operation.

Figure 2. Sampling of Liquid Drum Contents.

Nondestructive examination was carried out on several leaking and nonleaking drums to determine the effectiveness of the technique in identifying corrosion and to further characterize the drums. The raw data for the ultrasonic inspections is given in Appendix C. The inspections were performed with a Sonic Digi-Sonic Model 502™ readout instrument. The ultrasonic transducer was a Sonic, 1/4" diameter, 15 mHz™[1]. The couplant was Ultragel II™[2]. Inspections were carried out by R. M. Kowitz of the Westinghouse Hanford Company Nondestructive Examination section.

The corrosion morphology on the drum exterior was typically small through-wall holes, with corroded areas or blistered paint areas several inches in extent surrounding the holes. Failures occurred in all locations on the drum sides; from the top to the bottom, in rolling hoops, and at the bottom edge. The ultrasonic inspection yielded quantitative readings of wall thickness in areas where corrosion was minimal or not present. In all cases, the wall thickness readings were from 0.041 to 0.045 in. Where significant corrosion was present on the interior or exterior surface, no quantitative readings were possible with the instrumentation available; the data sheets in Appendix C state "no reading equals corrosion." Interior and exterior corroded areas were mapped out using visual inspection and ultrasonic readings. The maps are shown in the drawings in Appendix C.

The exterior of several failed drums in the storage stack is shown in Figure 3. Failure locations are marked by white circles on the bottom drums. Note the drum contents leaking from the top drum (89-DD-0103).

4.0 DRUM CORROSION

The failures of the drums are attributed to some form of corrosion. Mechanical damage can be quickly ruled out from the appearance and scenario involved with the failures. No evidence of mechanical effects such as damage from lifting or handling equipment is evident; no dents or gouges or deformation near the failed areas can be seen.

The question to be answered is what form of corrosion occurred and, more importantly, what corroding agent caused the failures. Of the various forms of corrosion, general corrosion and pitting corrosion seem the most likely causes. General corrosion is that which results in a rather uniform attack of the metal surface, and the metal thickness is removed at a fairly uniform rate at all affected surfaces. Pitting occurs in very localized areas without much associated general corrosion. Clues to the specific corroding agent can be found from the chemical analyses of the waste and from the literature regarding corrosive effects of waste components.

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[1]Sonic Digi-Sonic 502 Readout and the Sonic 1/4" 15 mHz transducer are both trademarks of Staveley Instruments, Kennewick, Washington.

[2]Ultragel II couplant is a trademark of Echo Laboratories, Lewistown, Pennsylvania.

Figure 3. Exterior of Failed Drums.

The appearance of the failures from the exterior of the drums suggests pitting, as the failure areas generally are small diameter holes. Some drums have large blisters rather than holes, but this is disbonded paint resulting from corrodant penetrating the steel wall and forcing the paint from the drum wall. The last step in the failure process is penetration of the paint layer. The interior surfaces of the drums show corrosion products from general corrosion but not enough attack to attribute failure to general corrosion.

Examination of the records of the waste drum contents shows that the principal constituent is sodium nitrate. Other constituents are potassium cyanide, sodium chromate, sodium cyanide, sodium fluoride, sodium nitrate, and sodium sulfate. The corrosion rates of carbon steel in aqueous solutions of these salts are 2 to 20 mils/yr with the exception of sodium fluoride, which has a rate of 20 to 50 mils/yr (Schweitzer 1986). These rates are from data taken at temperatures up to a maximum of 100 to 160 °F, with the exception of potassium cyanide, which had data up to 200 °F.

The corrosion rates would be expected to increase with increasing temperature. Data for corrosion of steel by sodium nitrate at 212 °F indicate uniform corrosion rates of 20 to 50 mils/yr (Hammer 1974).

Any aqueous solution will corrode steel at some rate, even in neutral or fairly high pH conditions, as long as some dissolved oxygen is present. In neutral aqueous solutions, depending on the dissolved oxygen content, steel will corrode at a rate from two to ten mils/yr. The corrosion rate drops off rather steeply as the pH rises above 10. However, if the protective oxide layer built up under alkaline conditions is interrupted by the action of some agent such as chloride ion, alkaline pH conditions are known to lead to pitting corrosion.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The cause of the failures was pitting corrosion of the drum walls. The most probable agent is sodium nitrate. This compound was noted in the samples of material that came through the holes in the drum wall, and is known to quickly corrode steel, particularly at temperatures near the boiling point of water. However, practically any of the components of the waste are able to corrode steel if enough water is present to facilitate the corrosive action.

The high temperatures experienced by the drums undoubtedly contributed to the speed of the corrosion process. Also the cyclic temperatures experienced could lead to condensation of moisture inside the drums, lowering the pH and accelerating corrosion. The exact temperatures reached inside the drums are not known. Temperatures near boiling could be expected inside the black painted drums, due to heat absorption. The expected general corrosion rates could exceed 50 mils/yr if temperatures were well over 200 °F, according to the literature, or a year time frame for penetration of the drum wall. The stated rates are for general corrosion and pitting rates can be several times that of general corrosion rates. It is possible that the corrosion initiated and proceeded to failure in a period of 1 to 2 mo during the high atmospheric temperatures of the summer. This is consistent with the fact that the drums had been filled for total times varying by a factor of two, yet all failed within a short time. The critical event was probably deterioration of the plastic liner, allowing liquid to reach the inside drum surface.

Any drum with the basin waste contents which has free liquid that can contact the drum wall can be expected to eventually corrode. The process may take years or weeks, dependent on the temperatures inside the drum. The plastic liners typically used in waste drums will prevent corrosion, as long as the liners do not deteriorate. The available ultrasonic methods of inspection can be used as "spot check" techniques but they can only give information on the areas directly surveyed. Inspecting an entire drum surface would take several hours. General corrosion which resulted in uniform wall thinning without significant surface irregularity could be investigated with quantitative results in terms of wall thickness changes. Pitting or rough corroded surfaces would result in only qualitative data; in other words, the presence or absence of corrosion could be detected, but quantitative wall thickness changes could not be read.

In conclusion, the corrosion is not surprising given the presence of free liquids in the drums and the deterioration of the drum liners. It is recommended that more reliable means of eliminating liquids in waste contents be employed and that plastic liners be used which are compatible with their environment, using conservative estimates of time and temperature. A separate report (Whitney 1990) has been prepared evaluating the compatibility of plastic liners with the waste storage environment, in response to action item 8.19 of Maier (1990). Drums should be stored in areas which do not allow exposure to ambient temperature or at least direct sunlight or precipitation (which will corrode the exterior surfaces). The remedies are quite basic: determine the expected conditions in a realistic manner and design appropriately.

Additionally, efforts should be directed toward developing a means of rapid nondestructive inspection for interior corrosion in drums. This may be improved ultrasonic probes or a completely different technique. The temperatures which can be reached inside the drums should also be measured directly to determine the actual environmental conditions which must be accounted for in container design.

6.0 REFERENCES

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APPENDIX A

VISUAL INSPECTION RESULTS

183-H MIXED WASTE PACKING INSPECTION

DRUM ID NUMBER 89-00-0049 SOAR NUMBER 3-1C-1KM-0

DATE SHIPPED TO CWC 09/05/89 INSPECTION DATE 07/19/90

EXPECTED CONTENTS Sandblast grit

CURRENT CONDITION Non-problem drum

ACTUAL CONTENTS Absorbent and cleanup waste 1

NOTE CONDITIONS OF DRUM INTERIOR & LINER Liner folded over and taped. Drum interior lightly corroded except where liner creases/folds present. Upper portion of liner deteriorated.

NOTE pH OF LIQUID MATERIAL N/A

COMMENTS OR OTHER OBSERVATIONS: Drum not pressurized. Very light in weight.

1 Solar Basin 3 sign, plastic lid, paper, misc. waste

INFORMATION RECORDED BY H.L. Garrison DATE 07/19/90

ORGANIZATION HRO-OE PHONE 3-5496

Document No.	Rev/Mod	Page

9413137.2066

183-H MIXED WASTE PACKING INSPECTION

DRUM ID NUMBER 89-DD-0050 SDAR NUMBER 3-IC-1KM-0

DATE SHIPPED TO CWC 09/05/89 INSPECTION DATE 07/19/90

EXPECTED CONTENTS Sandblast grit

CURRENT CONDITION Leaking drum

ACTUAL CONTENTS Sludge

NOTE CONDITIONS OF DRUM INTERIOR & LINER Liner not visible on top.

Liner very brittle and deteriorated at top, improving with depth.

Lower 3/4 of liner in good shape.

NOTE pH OF LIQUID MATERIAL Top = 10; bottom = 10

COMMENTS OR OTHER OBSERVATIONS: Strong.odor of organic chemical.

Pressurized. Contents very damp; lots of liquid.

Liquid runoff - sample #1004

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ORGANIZATION HRO-DE PHONE 3-5496

Document No.	Rev/Mod	Page

183-H MIXED WASTE PACKING INSPECTION

DRUM ID NUMBER- 89-DD-0052 SOAR NUMBER 3-1C-1KM-0

DATE SHIPPED TO CWC 09/05/89 INSPECTION DATE 07/19/90

EXPECTED CONTENTS Sandblast grit

CURRENT CONDITION Non-problem drum

ACTUAL CONTENTS Misc. cleanup waste 1 and absorbent

NOTE CONDITIONS OF DRUM INTERIOR & LINER Very minor corrosion on interior surfaces of drum. Liner folded over on top and appears to be in good condition. Interior of drum corroded at liner fold marks.

NOTE pH OF LIQUID MATERIAL N/A

COMMENTS OR OTHER OBSERVATIONS: Drum pressurized. Very light in weight. Some moisture present between liner and drum.

1 Tumbleweed, rubbish, barbed wire, rain gear, etc.

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ORGANIZATION HRO-DE PHONE 3-5496

9413137.2068

Document No.	Rev/Mod	Page

183-H MIXED WASTE PACKING INSPECTION

DRUM ID NUMBER 89-DD-0373 SDAR NUMBER 3-1C-38M-0

DATE SHIPPED TO CWC 10/09/89 INSPECTION DATE 07/20/90

EXPECTED CONTENTS Solidified liquid

CURRENT CONDITION Drum in good condition. Contents appear in good condition. Non-problem drum.

ACTUAL CONTENTS Solidified liquid.

NOTE CONDITIONS OF DRUM INTERIOR & LINER Drum interior in excellent condition. Drum liner like new. No voids or liquids observed.

NOTE pH OF LIQUID MATERIAL N/A (solid material)

COMMENTS OR OTHER OBSERVATIONS:

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ORGANIZATION HRO-DE PHONE 3-5496

Document No.	Rev/Mod	Page

183-H MIXED WASTE PACKING INSPECTION

DRUM ID NUMBER 89-00-0103 SDAR NUMBER 3-1C-1KM-0

DATE SHIPPED TO CWC 09/11/89 INSPECTION DATE 07/19/90

EXPECTED CONTENTS Sandblast grit

CURRENT CONDITION Leaking drum

ACTUAL CONTENTS Absorbent and cleanup waste 1

NOTE CONDITIONS OF DRUM INTERIOR & LINER Liner not visible at all above damp contents. Liner very brittle and deteriorated at top but improving with depth. Top 1/4 of drum was corroded (void spaces).

NOTE pH OF LIQUID MATERIAL 10 at top; 11 at bottom

COMMENTS OR OTHER OBSERVATIONS: Too light weight to be grit. Leaked liquid upon removal from overpack. Strong smell of organic chemicals. Liquid leaked from closed drum upon removal from overpack.

1 Plastic bags, 1/2 full can of spray paint, paper sack (absorbent). Liquid runoff - sample #1001

INFORMATION RECORDED BY H. L. Garrison DATE 07/19/90

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Document No.	Rev/Mod	Page

183-H MIXED WASTE PACKING INSPECTION

DRUM ID NUMBER 88-00-0438 SOAR NUMBER 3-1A-1KM-1

DATE SHIPPED TO CWC 09/07/88 INSPECTION DATE 07/19/90

EXPECTED CONTENTS Sludge

CURRENT CONDITION Leaking drum

ACTUAL CONTENTS Sludge

NOTE CONDITIONS OF DRUM INTERIOR & LINER Liner appears to be in good shape, but there was a lot of liquid between drum and liner. Outside of drum looked badly corroded, but inside had minimal corrosion.

NOTE pH OF LIQUID MATERIAL 11

COMMENTS OR OTHER OBSERVATIONS: 400 cpm direct at rusty patch, 500 cpm inside. Only 1 or 2 shovels of absorbent seemed to be present in drum. Liquid leaked from closed drum upon removal from overpack.

Runoff liquid - sample #1002

INFORMATION RECORDED BY H. L. Garrison DATE 07/19/90

ORGANIZATION HRO-DE PHONE 3-5496

Document No.	Rev/Mod	Page

183-H MIXED WASTE PACKING INSPECTION

DRUM ID NUMBER 88-00-0439 SOAR NUMBER 3-1A-1KM-1

DATE SHIPPED TO CWC 09/07/88 INSPECTION DATE 07/19/90

EXPECTED CONTENTS Sludge

CURRENT CONDITION Non-problem drum

ACTUAL CONTENTS Damp sludge (no absorbent)

NOTE CONDITIONS OF DRUM INTERIOR & LINER Liner folded over and taped. Drum interior looks good with only random spots of corrosion above second roll ring. Liners are in good shape.

NOTE pH OF LIQUID MATERIAL Top = 12; Bottom portion = 12

COMMENTS OR OTHER OBSERVATIONS: 400 cpm direct inside drum. Unable to obtain liquid runoff sample (only 2 drops).

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Document No.	Rev/Mod	Page

183-H MIXED WASTE PACKING INSPECTION

DRUM ID NUMBER 88-00-1407 SOAR NUMBER 3-1A-1KM-1

DATE SHIPPED TO CWC 11/03/88 INSPECTION DATE 07/19/90

EXPECTED CONTENTS Sludge

CURRENT CONDITION Leaking drum

ACTUAL CONTENTS 7 plastic bags, absorbent, 1/2 liquid, 1/2 sludge

NOTE CONDITIONS OF DRUM INTERIOR & LINER Liner was folded over and taped (not pigtailed). Liner intact with moisture (not real wet) outside. Contents moist. Drum interior corroded heavily down to second roll ring.

NOTE pH OF LIQUID MATERIAL 10 at top; 11 at bottom

COMMENTS OR OTHER OBSERVATIONS: Not pressurized

Liquid runoff - sample #1003

INFORMATION RECORDED BY H. L. Garrison DATE 07/19/90

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9413137.2073

Document No.	Rev/Mod	Page

APPENDIX B

ANALYTICAL RESULTS

Battelle
Pacific Northwest Laboratories

Project Number ______________

Internal Distribution

File/LB

Date September 25, 1990

To J. B. Maier

From E. D. Jensen

Subject X-Ray Diffraction Results on Oxidizer Samples

Samples of salts which corroded through the 183H drums.

X-Ray diffraction has ben carried out on 4 samples of oxidizer labelled DD 023 #1407, WHC 89001 #89001 #89-DD-0903, DD 007 #438, and WHC 89001 #89-DD-0050. Sodium nitrate was found in all samples. Oxonium iron sulfate hydroxide was found in one, and sodium fluoride sulfate was found in 2 samples. A fifth sample, labelled 89-DD-0050 was not examined due to lack of adequate sample.

The following table indicates the findings for each sample:

Sample ID	Phases identified	
DD023 #1407	sodium nitrate	sodium fluoride sulfate
WHC 89001 #89-DD-0903	sodium nitrate	oxonium iron sulfate hydroxide
DD007 #438	sodium nitrate	
WHC 89001 #89-DD-0050	sodium nitrate	sodium fluoride sulfate

Sodium nitrate, Na NO3, was identified in all samples. Since it was the bulk constituent, peak data attributable to this phase was subtracted from the experimental data and further searching was done on the residuals.

Sodium fluoride sulfate, Na3 F SO4, was found in samples 1407 and 0050. This phase is distinct from Na2 SO4 and Na F. The spectra of Na2 SO4 and Na F do not match the observed pattern. These phases have evidently combined to form the observed sodium fluoride sulfate. The concentration of this phase appears to be in the 10-20% range.

Oxonium iron sulfate hydroxide, H3O Fe3 (SO4)2 (OH)6, was found in the 0903 sample and appears to be a minor constituent, ie less than 5%.

Plots of the background subtracted data, with stick figure representations of the spectra of phases identified, are included for each sample.

J. B. Maier
September 25, 1990
Page 2

The abbreviations on the accompanying plots are as follows:

FN = File name,
ID = Sample identification or comment,
Date = Date the run was started,
Time = Time the run was started,
Pt = Counting time, in seconds, at each angular position,
Step = Angular step size, in degrees, 2-theta,
WL = Wavelength of the X-rays used.

The samples were received as mixtures of light and dark phases in plastic bottles. A representative sample of the material was removed and pulverized in a mortar and pestle to provide the fine powder needed for proper X-ray diffraction work. The powder was pressed into standard bulk holders and carefully smoothed and compressed. Data acquisition was over the range 5 to 65 degrees 2-theta for 1 hour (1.2 seconds per step). Step size was 0.02 degrees 2-theta. Tube conditions were 45 KV and 40 MA.

The instrument used was the Scintag Pad V X-ray diffractometer in room 409 of the 325 building, property tag number WB24321. The work was performed to HTA-3-3, Solids Analysis, X-ray Diffraction Analysis. Calibration data are in LRB BNW 52334. Daily calibration checks showed the instrument to be in calibration are at all times. Test parameters are in LRB BNW 52332. Training records of the operator, E. D. Jenson, are on file in the Chemical Measurements Laboratory office.

Additional information can be obtained from E. D. Jenson, on 376-9072 if desired.

APPENDIX C

ULTRASONIC INSPECTION RESULTS

Westinghouse Hanford Company

ULTRASONIC THICKNESS MEASUREMENT PROCEDURE AND TEST REPORT

NONDESTRUCTIVE EXAMINATION
306 BLDG., 300 AREA - TEL. 376-5401

Job No. 90-214

Request/Inst. No. 6130

Requester (client)	Company	MSIN	Bldg.	Area
D Duncan	WHC	R2-87	2750	2E

Copy To	■ NA	MSIN	Bldg.	Area

Project/System/Work Package/Traveler No. Waste drums at Central Waste Complex

PART INFORMATION

Material: C/S

Wall Thickness: Approx .060" ☐ NA

Diameter: ■ NA

Schedule: ■ NA

Size: ■ NA

Acceptance Std. Section Para. Date ■ NA: Info Only

Dwg. No. ■ NA

NCR ■ NA

WHC PROCEDURE NO.

NDT-UT-9000, Revision No. 1

Appendix H, Revision No. 1 RMK 7-23-90

Special Technique No. ☐ NA

COVERAGE

■ Spot

☐ 100% of area requested

INSTRUMENTATION

Digi-Sonic

Mfg. Sonic Model 502

Standards Lab No. 584-31-50-016

Expiration Date 7-19-91

CALIBRATION STANDARD(S)

Standards Lab No. 584-99-30-091

Expiration Date 11-13-90

Standards Lab No. 584-99-30-117

Expiration Date 2-21-92

TRANSDUCER

Diameter 1/4"

Frequency 15 MHZ

Mfg. Sonic

Serial No. 17726T

Stand Off 1/2"

Couplant Ultracell II

Batch No. 8557

RESULTS

These Drums have blisters from inside Corrosion. Size and location as noted. See Pages 2 thru 7. Inside Corrosion was mapped by taking Thickness Readings. No Reading equals Corrosion. Thickness Readings noted are as close to blister a Reading could be taken. This was marked and then used for the size of the inside corrosion.

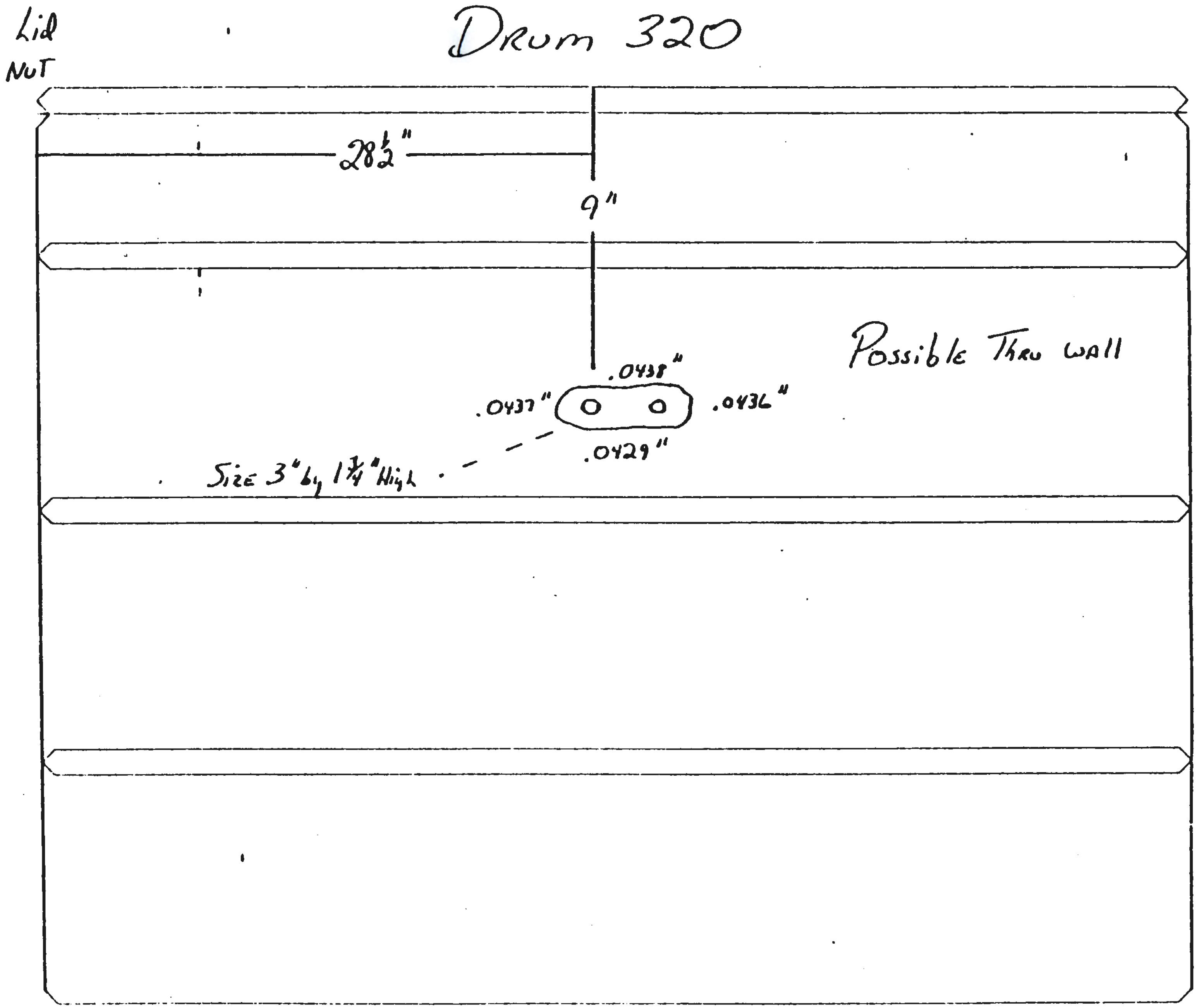
○ - Indicates either a blister or thru wall indication.

RECORD COPY

Technician	UT Level	Interpreted by	UT Level II	~~UT Level III Review~~ Mgr. NDE
[signature]	II	[signature]	II	N. C. Hartwick
Date of examination 7-23-90		Date of examination 7-23-90		Date 7-24-90

A-6000-507 (3.90)

Drum 320

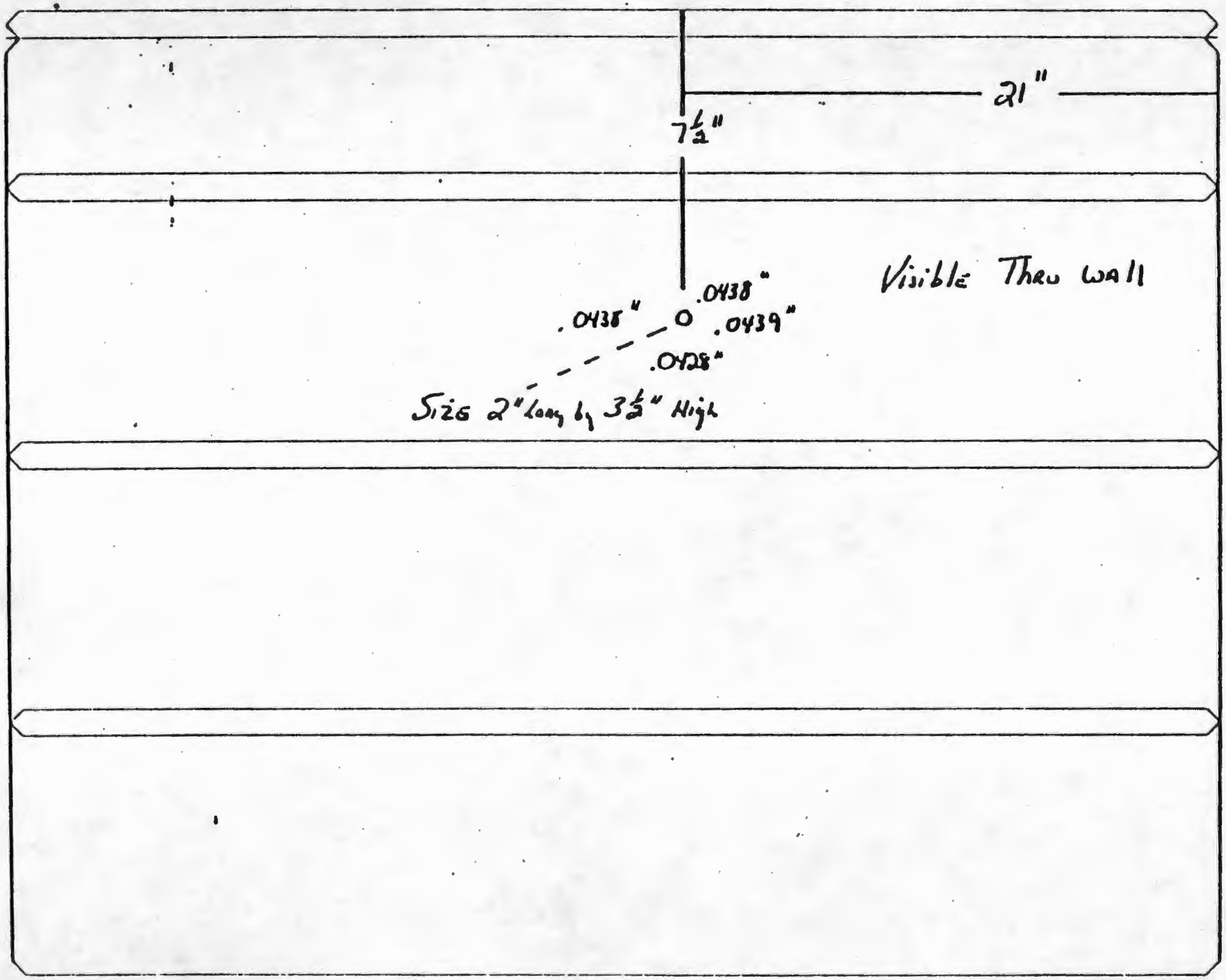


RI 6130
Job 90-214

9413137.2080

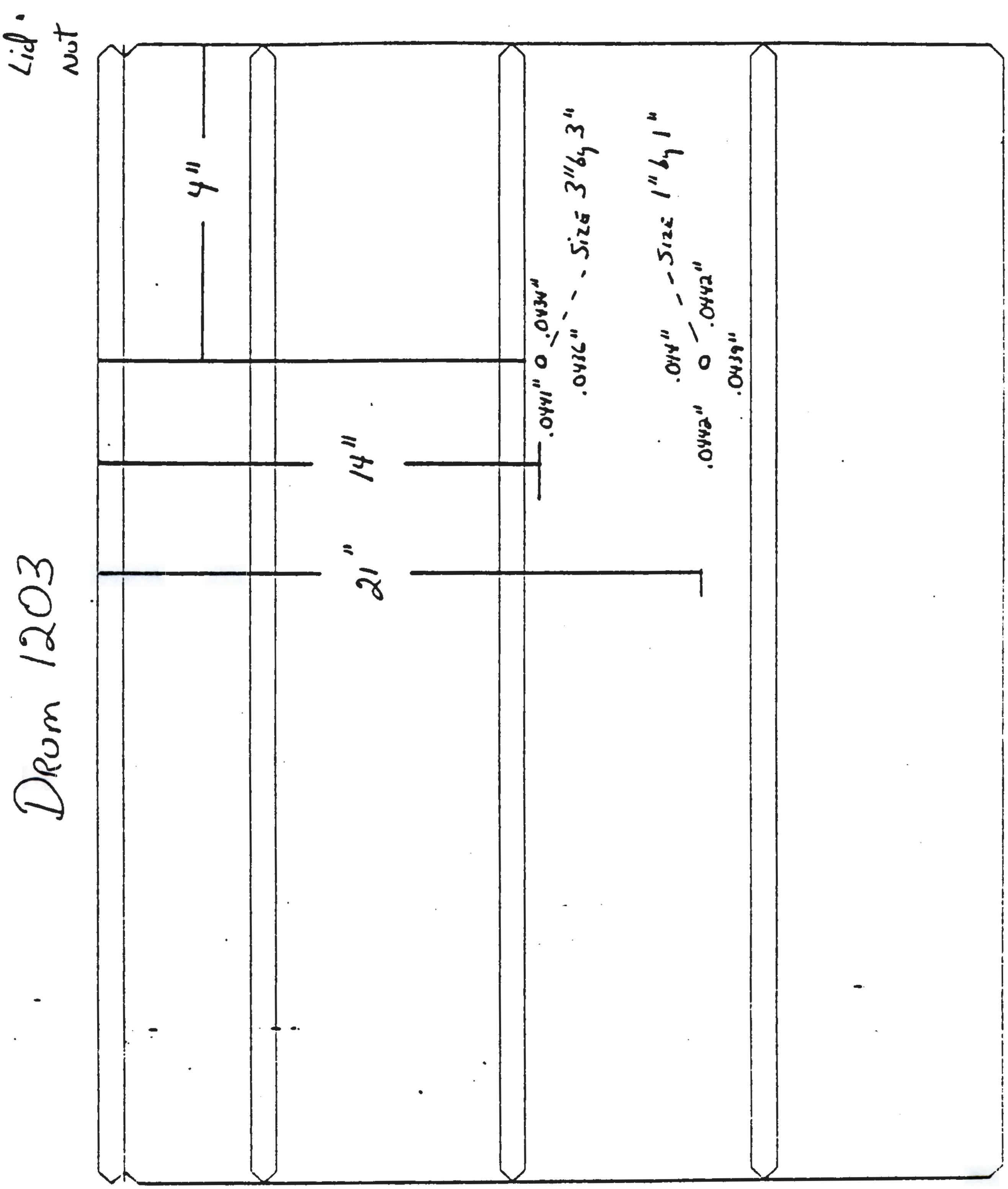
Drum 340

Lid: Not



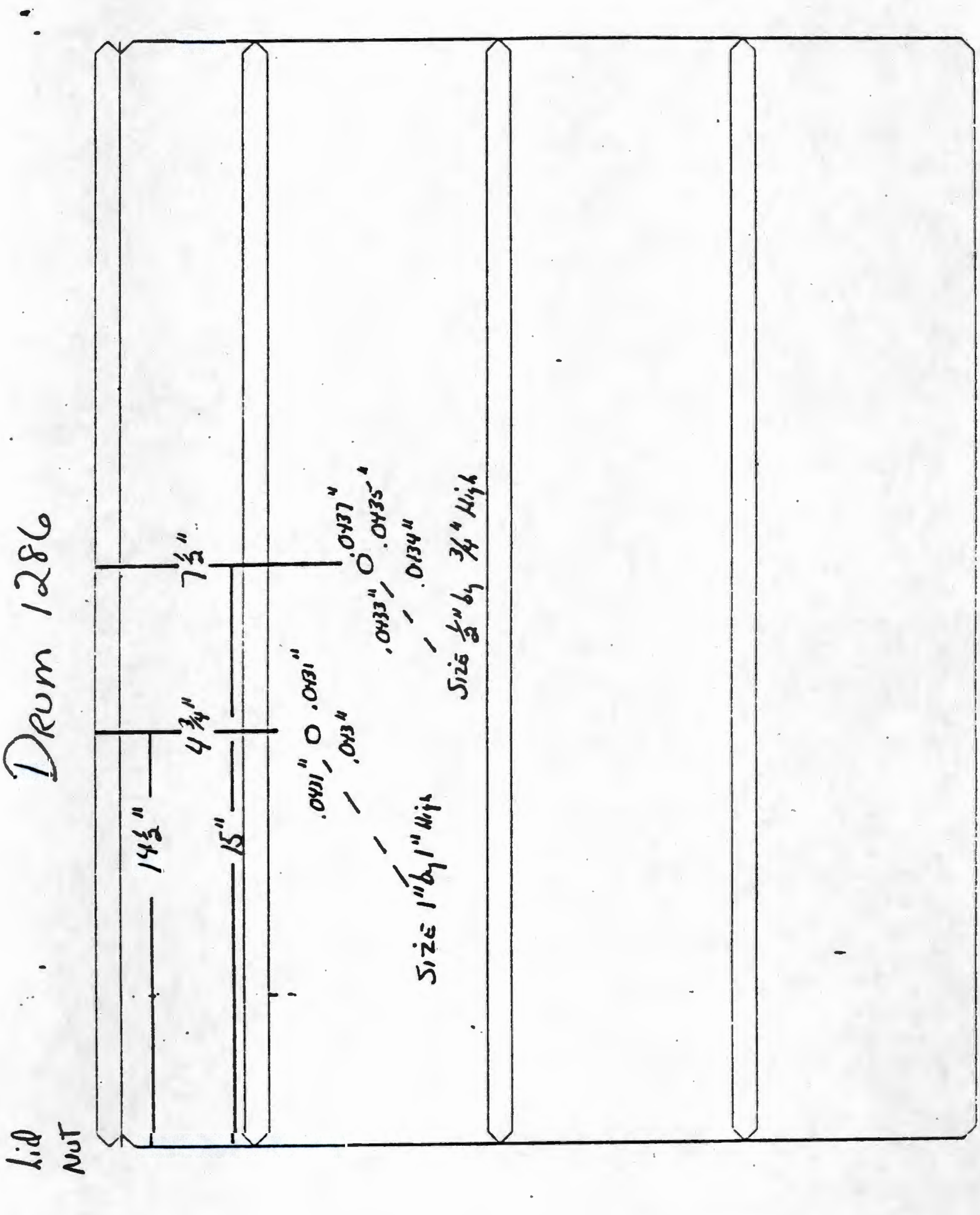
RT6130
Job # 90-214
Page 3 of 7

RI 6130
Job #90-214



RI 6130
Job # 90-214

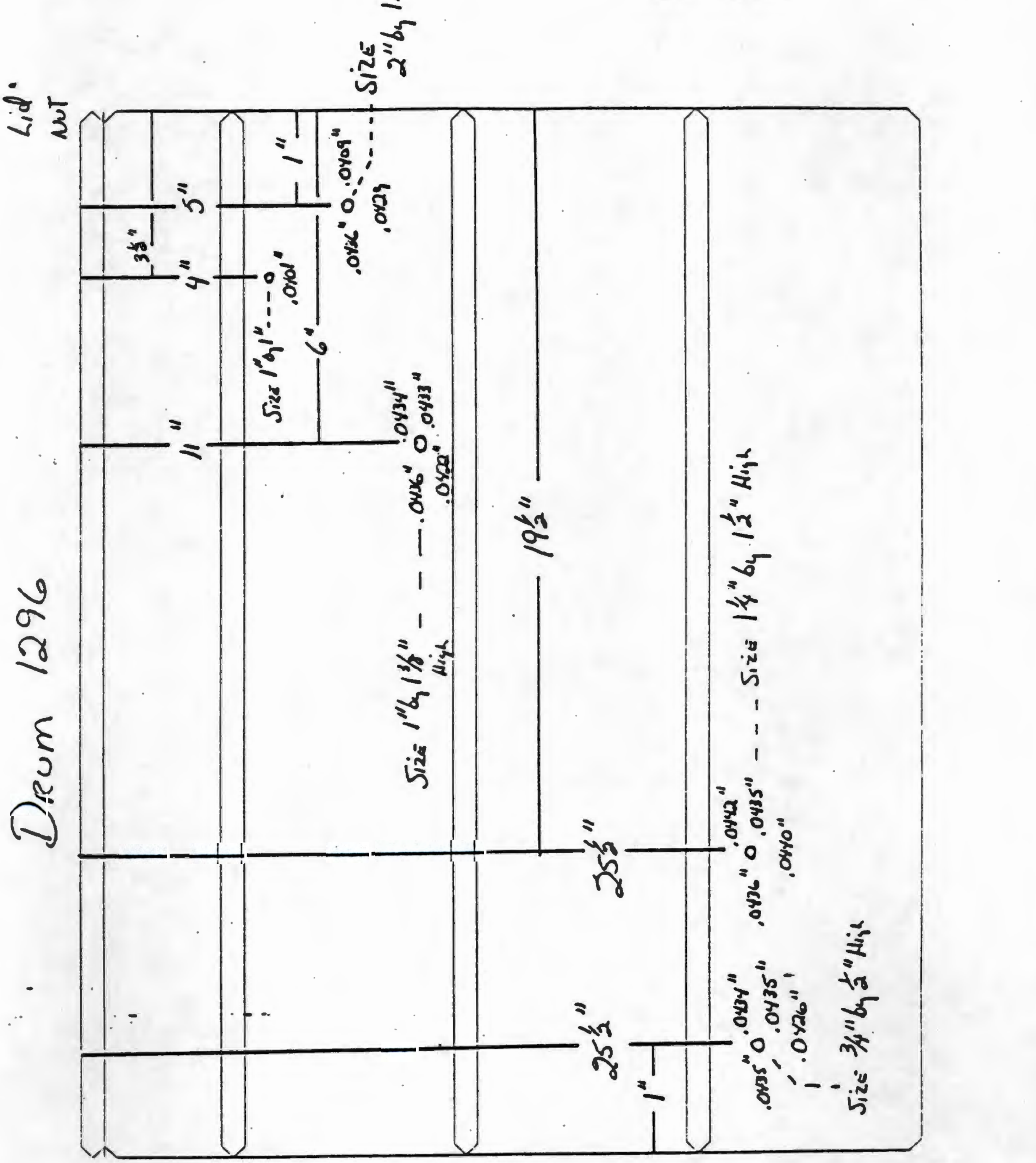
9413137.2082



RI 6130
Job # 90-214

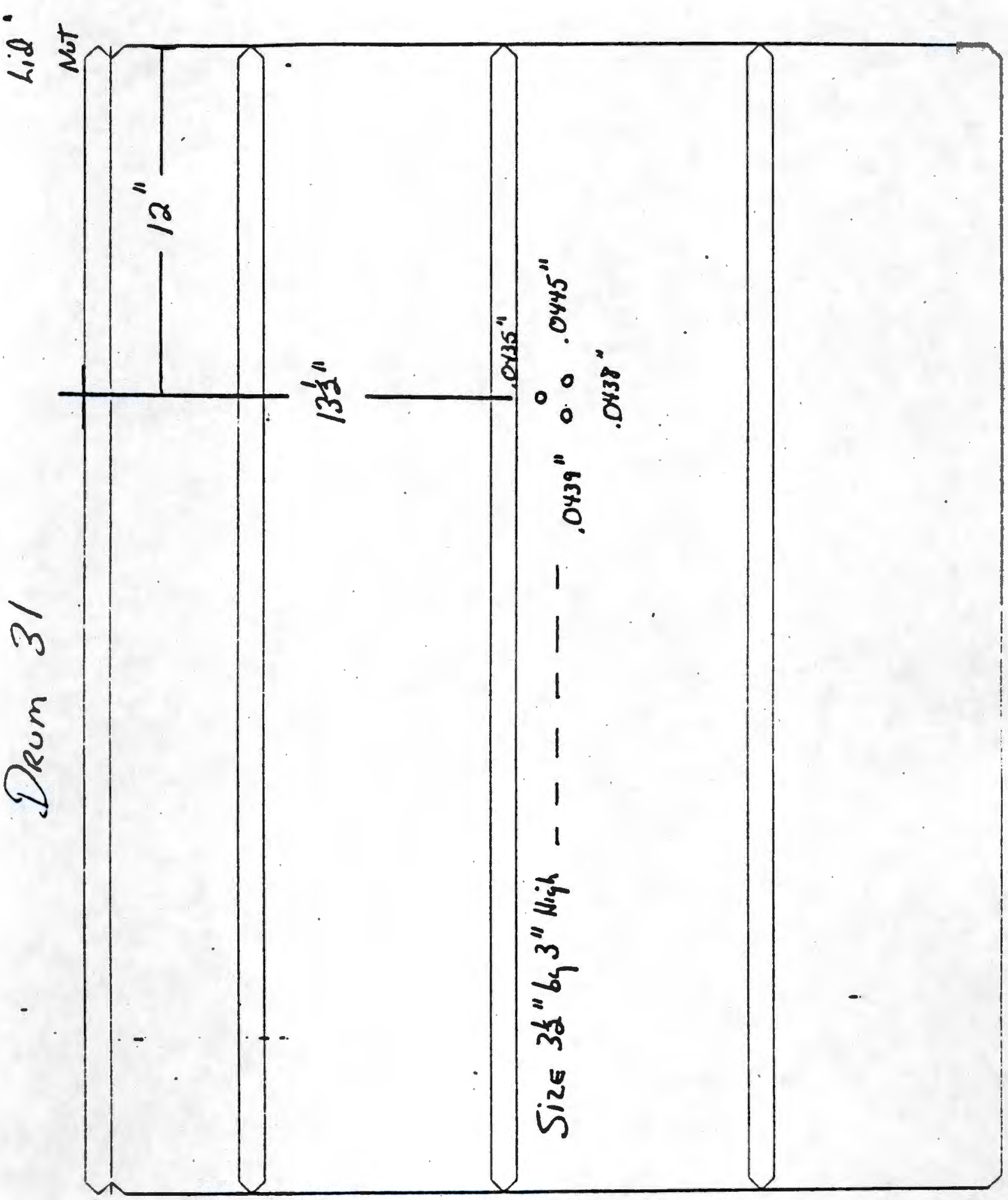
Page 6 of 7

9413137.2083



RI 6130
Job# 90-214

9413137.2084



Page 1 of 12

Westinghouse Hanford Company	ULTRASONIC THICKNESS MEASUREMENT PROCEDURE AND TEST REPORT NONDESTRUCTIVE EXAMINATION 306 BLDG., 300 AREA - TEL. 376-5401	Job No. 90-214	Request/Inst. No. 6130

Requester (client): D. DUNCAN — Company: WHC — MSIN: R2-87 — Bldg.: 2750 — Area: 2E

Copy To: ■ NA — MSIN — Bldg. — Area

Project/System/Work Package/Traveler No. 100 H AREA

DRUMS

PART INFORMATION

Material: CS

Wall Thickness: Approx .044" ☐ NA

Diameter ■ NA

Schedule ■ NA

Size ■ NA

Acceptance Std.: Info Only — Section — Para. — Date ■ NA — Dwg. No. ■ NA — NCR ■ NA

WHC PROCEDURE NO.

NDT-UT-9000, Revision No. 1

Appendix ~~X~~ H RMF 7-26-90, Revision No. 1

Special Technique No. ■ NA

COVERAGE

☐ Spot

■ 100% of area requested

INSTRUMENTATION

Mfg. Sonic Model Digi Sonic 502

Standards Lab No. 584-31-50-016

Expiration Date 7-19-91

CALIBRATION STANDARD(S)

Standards Lab No 584-99-30-118

Expiration Date 2-21-92

Standards Lab No. 584-99-30-091

Expiration Date 11-13-90

TRANSDUCER

Diameter 1/4"

Frequency 15 MHZ

Mfg. Sonic

Serial No CB815-1

Stand Off built in

Couplant UltraGEL II

Batch No 8557

RESULTS

See Pages 2 Thru 12 for Results

RECORD COPY

Technician	UT Level	Interpreted by	UT Level II	~~UT Level III~~ Review
R M Jowitz	II	Robert M Jowitz	II	N. C. Hartford (Mgr. NDE)
Date of examination 7-26-90		Date of examination 7-26-90		Date 7-26-90

A-6000-507 (3/90)

Westinghouse Hanford Company	NONDESTRUCTIVE TEST REPORT NONDESTRUCTIVE EXAMINATIONS 306 BLDG., 300 AREA - TEL. 376-5401	Report No. 90-214 RS 6130 Date 7-26-90

DRUM NUMBER 89-DD-0050

TOP	BOTTOM
N/A	.0433"
	.0427"

TOP

AREA 1

AREA 2

AREA 3

AREA 4

AREA 1	AREA 2	AREA 3	AREA 4
.0425"	.0436"	.0437"	.0426"
.0423"	.0432"	.0438"	.0427"
.0414"	.0437"	.0438"	.0425"
.0424"	.0432"	.0435"	.0433"

TAKEN APPROXIMATELY 90° APART

RECORD COPY

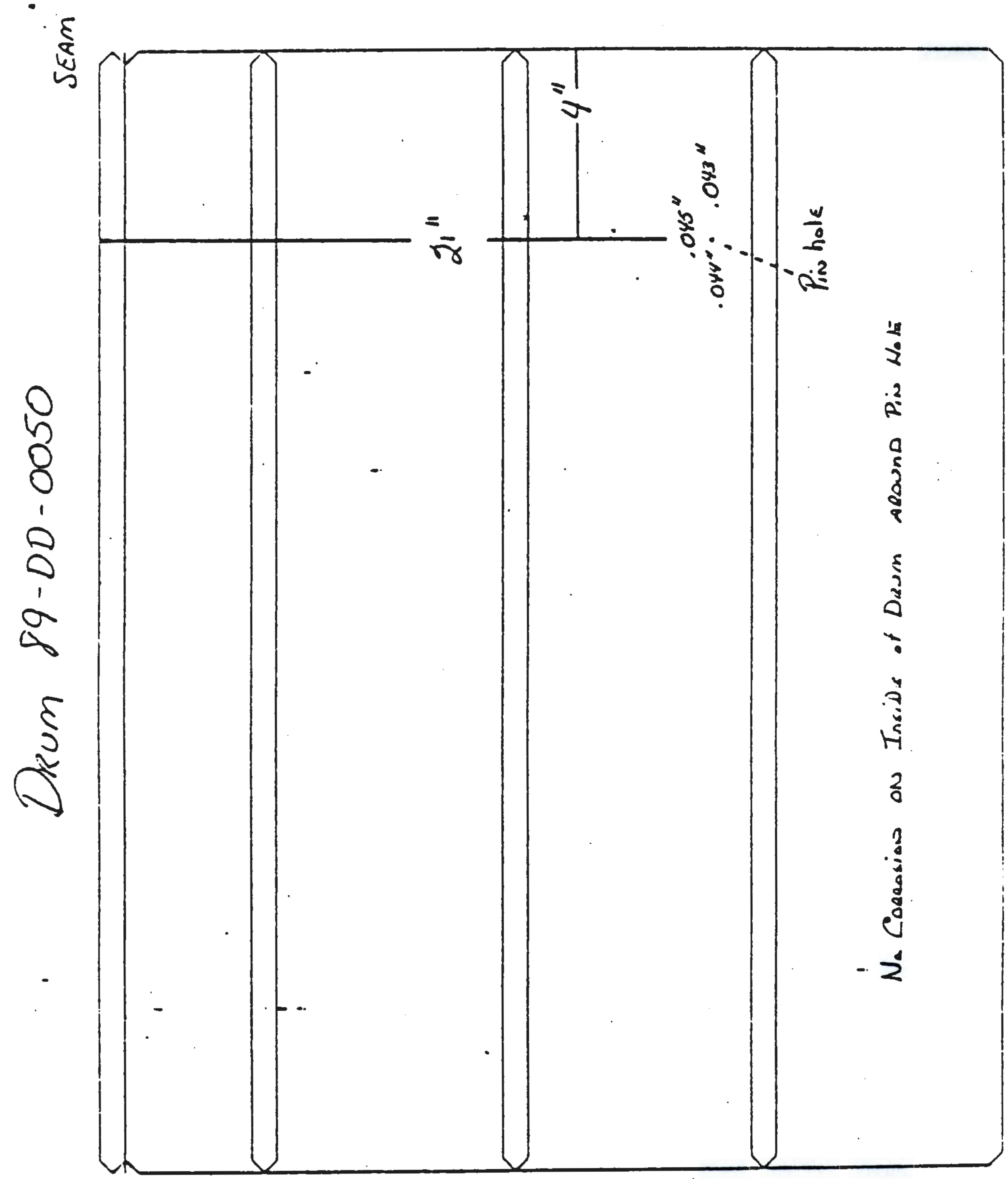
AI Review	Date
■ NA	

Technician	Level	Interpreted by	Level II	~~Level III Review~~ Mgr. NDE
RMKowitz	I	Robert M Kowitz	II	M. C. Hartsuk
Date 7-26-90		Date 7-26-90		Date 7-26-90

A-7900-057 (01-88)

9413137.2086

RI 6130
Job #90-214



Westinghouse Hanford Company	NONDESTRUCTIVE TEST REPORT NONDESTRUCTIVE EXAMINATIONS 306 BLDG., 300 AREA - TEL. 376-5401	Report No. 90-214 RE6130 Date 7-26-90

183-H4

DRUM NUMBER 1407

TOP	BOTTOM
N/A	.0441"
	.0434"

TOP

AREA 1
AREA 2
AREA 3
AREA 4

AREA 1	AREA 2	AREA 3	AREA 4
.0427"	.0445"	.0442"	.0430"
.0423"	.0432"	.0437"	.0427"
.0423"	.0440"	.0444"	.0435"
.0423"	.0438"	.0440"	.0432"

TAKEN APPROXIMATELY 90° APART

Drum has a lot of Corrosion on Inside

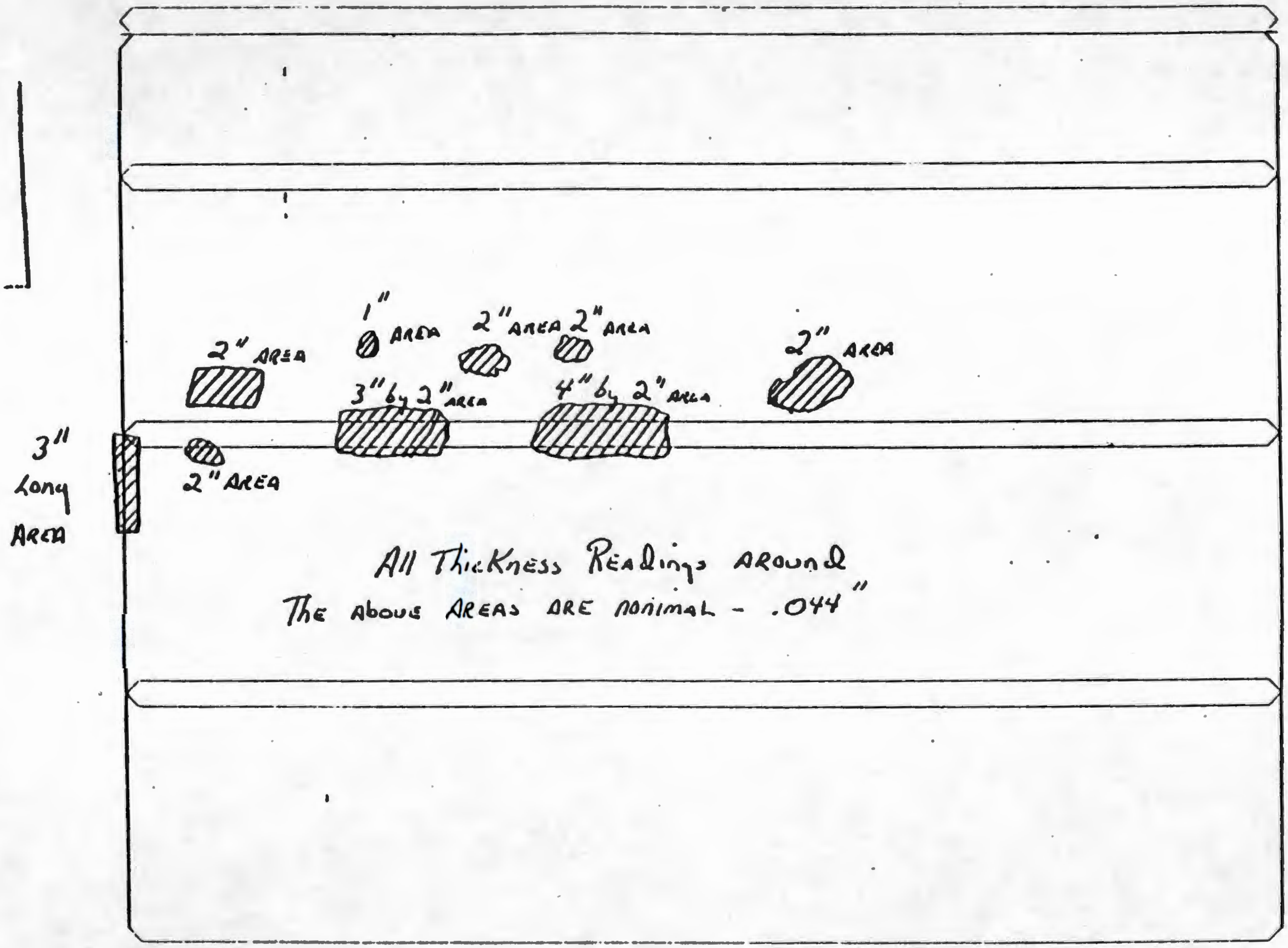
RECORD COPY

AI Review	Date
■ NA	

Technician	Level	Interpreted by	Level II	Level III Review
R M Towitz	II	Robert M Towitz	II	Mgr. NDE N. P. Harland
Date 7-26-90		Date 7-26-90		Date 7-26-90

A-7900-057 (01-88)

Drum 1407 183-H4



Corrosion Areas on Outside of Drum (Blisters)

RT6130
Job #90-214

Westinghouse Hanford Company

NONDESTRUCTIVE TEST REPORT

NONDESTRUCTIVE EXAMINATIONS
306 BLDG., 300 AREA - TEL. 376-5401

Report No. 90-214 RI 6130
Date 7-26-90

183-H4

DRUM NUMBER 439

TOP	BOTTOM
N/A	.0435"
	.0431"

TOP
AREA 1
AREA 2
AREA 3
AREA 4

AREA 1	AREA 2	AREA 3	AREA 4
.0435"	.0440"	.0442"	.0428"
.0435"	.0437"	.0439"	.0431"
.0431"	.0433"	.0432"	.0425"
.0426"	.0437"	.0437"	.0430"

TAKEN APPROXIMATELY 90° APART

No Blisters on Outside of Drum

Inside of Drum is clean

AI Review	Date
■ NA	

Technician	Level	Interpreted by	Level II	~~Level III Review~~ Mgr. NDE
RM Jowitz	II	Robert M Jowitz	II	N. P. Hostink
Date 7-26-90		Date 7-26-90		Date 7-26-90

A-7900-057 (01-88)

9413137.2090

Westinghouse Hanford Company	NONDESTRUCTIVE TEST REPORT NONDESTRUCTIVE EXAMINATIONS 306 BLDG., 300 AREA - TEL. 376-5401	Report No. 90-214 6130 Date 7-26-90

183-H4

DRUM NUMBER 438

TOP	BOTTOM
N/A	.0435"
	.0437"

TOP

AREA 1
AREA 2
AREA 3
AREA 4

AREA 1	AREA 2	AREA 3	AREA 4
.0437"	.0443"	.0443"	.0426"
.0440"	.0443"	.0443"	.0424"
.0439"	.0444"	.0443"	.0445"
.0442"	.0453"	NO READING	NO READING

OUTSIDE CORROSION AREA

TAKEN APPROXIMATELY 90° APART

AI Review	Date
NA	

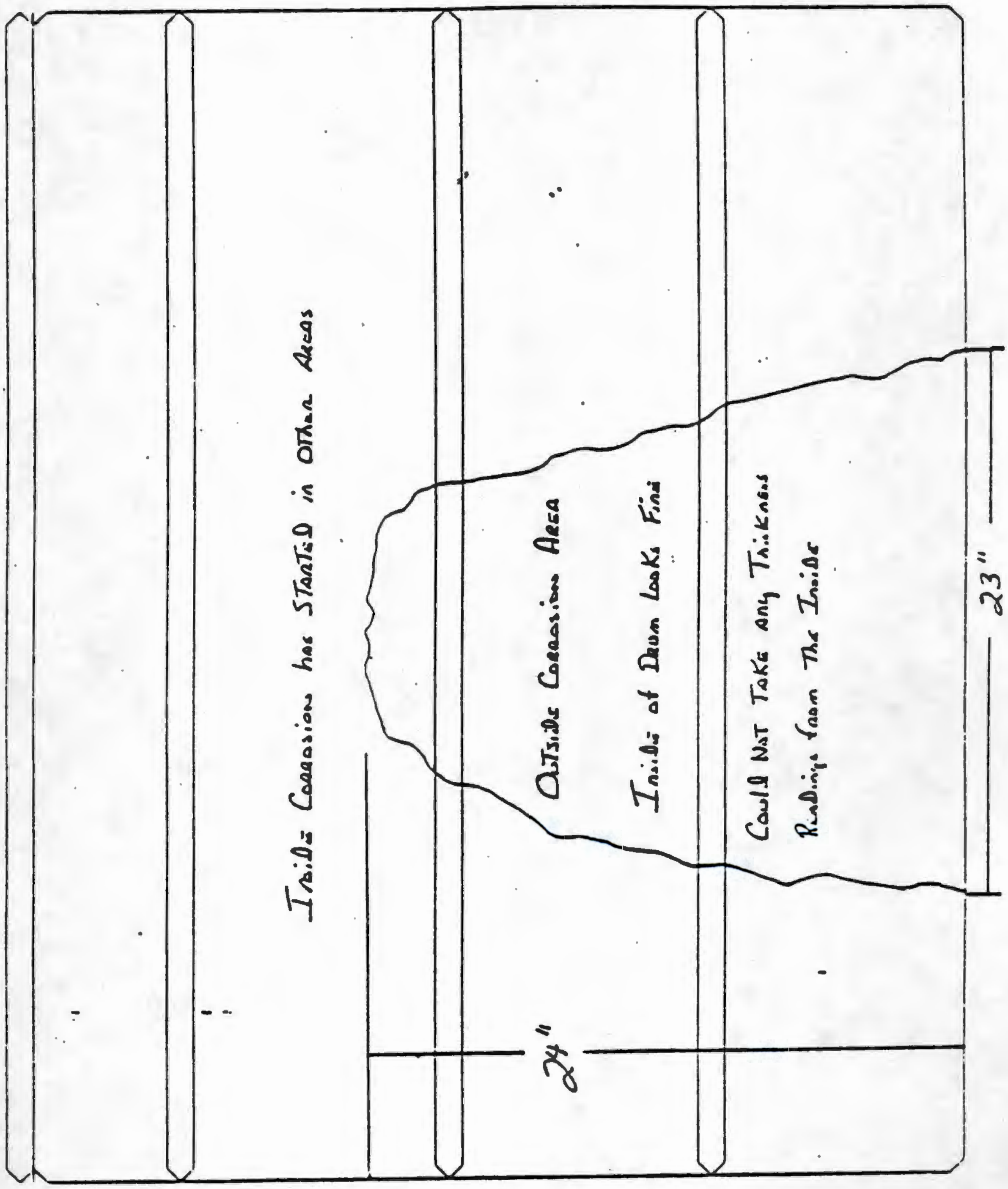
Technician	Level	Interpreted by	Level II	Level III Review
RM Fowitz	II	Robert M Fowitz	II	Mgr. NDE N. P. [illegible]
Date 7-26-90		Date 7-26-90		Date 7-26-90

A-7900-057 (01-88)

RI 6130
Job # 90-214

9413137.2092

Drum 438
183-H4

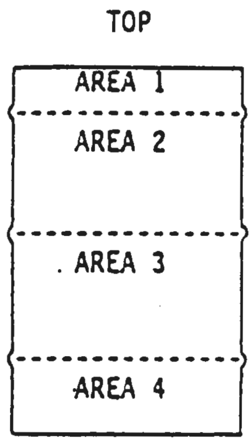


Page ~~8~~ 9 of ~~11~~ 12

Westinghouse Hanford Company	**NONDESTRUCTIVE TEST REPORT** NONDESTRUCTIVE EXAMINATIONS 306 BLDG., 300 AREA - TEL. 376-5401	Report No. 90-214 Date 7-26-90

DRUM NUMBER 89-DD-0103

TOP	BOTTOM
N/A	.0416"
	.0427"



AREA 1	AREA 2	AREA 3	AREA 4
.0440"	.0443"	.0442"	.0442"
.0432"	.0434"	.0433"	.0434"
.0434"	.0439"	.0436"	.0439"
.0436"	.0449"	.0437"	.0435"

TAKEN APPROXIMATELY 90° APART

AI Review	Date
■ NA	

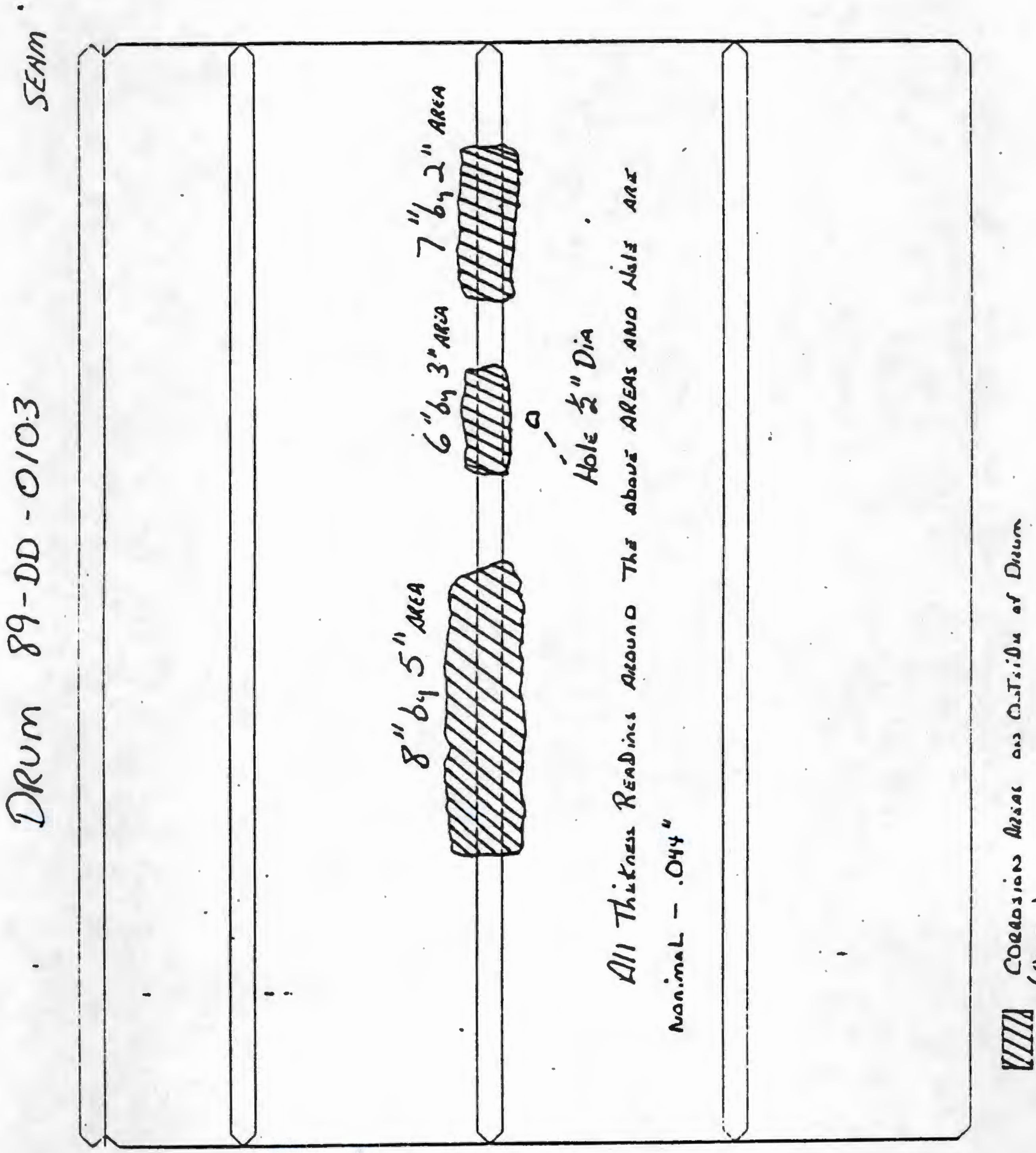
Technician	Level	Interpreted by	Level II	~~Level III Review~~
R M Tawitz	II	Robert M Tawitz	II	N. C. Hiltenbrand
Date 7-26-90		Date 7-26-90		Date 7-26-90

A-7900-057 (01 38)

RI 6130
Job # 90-214

Page ~~9~~ 10 of ~~11~~ 12

9413137.2094



Westinghouse Hanford Company	NONDESTRUCTIVE TEST REPORT NONDESTRUCTIVE EXAMINATIONS 306 BLDG., 300 AREA - TEL. 376-5401	Report No. 90-214 RI 6130 Date 7-26-90

DRUM NUMBER 89-DD-0049

TOP	BOTTOM
N/A	.0421"
	.0411"

TOP

AREA 1

AREA 2

AREA 3

AREA 4

AREA 1	AREA 2	AREA 3	AREA 4
.0425"	.0429"	.0433"	.0412"
.0421"	.0431"	.0434"	.0440"
.0424"	.0435"	.0436"	.0441"
.0424"	.0434"	.0438"	.0421"

TAKEN APPROXIMATELY 90° APART

No Blisters on Outside of Drum

RECORD COPY

		AI Review Date ■ NA
Technician RM Kowitz Level II	Interpreted by Robert M Kowitz Level II	Level III Review Mgr. NDE N. P. Antinez
Date 7-26-90	Date 7-26-90	Date 7-26-90

A-7900-057 (01 38)

Page 12 of 12

NONDESTRUCTIVE TEST REPORT

NONDESTRUCTIVE EXAMINATIONS
306 BLDG., 300 AREA - TEL. 376-5401

Report No. 90-214 RL 6130

Date 7-26-90

DRUM NUMBER 89-DD-0052

TOP	BOTTOM
N/A	.0437"
	.0421"

TOP

AREA 1
AREA 2
AREA 3
AREA 4

AREA 1	AREA 2	AREA 3	AREA 4
.0420"	.0432"	.0434"	.0433"
.0419"	.0431"	.0434"	.0430"
.0428"	.0433"	.0437"	.0432"
.0423"	.0434"	.0437"	.0404"

TAKEN APPROXIMATELY 90° APART

No Blisters on Outside of Drums

RECORD COPY

AI Review	Date
■ NA	

Technician	Level	Interpreted by	Level II	Level III Review
RM Kowitz	II	Robert M Kowitz	II	N-R Kirtland ...
Date 7-26-90		Date 7-26-90		Date 7-26-90

A-7900-057 (01-381)